



Figure 1. Exploded view of the 2U SurfSat CubeSat, showing key components, including deployable elements and exterior-mounted components.

Brief Overview: The space radiation environment in Earth's atmosphere is filled with hot and low-density plasmas that can cause charge to build up on spacecraft surfaces, resulting in high differential voltages and subsequent electrostatic discharges. These discharges can damage avionics and/or scientific instruments on spacecraft. SurfSat will take in-situ measurements of the ground current waveforms from chosen common spacecraft dielectric material samples, measure the spacecraft and material potentials, and will use a Langmuir probe system to measure the ambient plasma environment. The sample materials will span a range of resistivities that will be chosen both for relevance and in order to maximize scientific return. Comparison of on-orbit ESD measurements with completed and ongoing plasma chamber charging experiments will be used to validate current plasma charging test methods. These experiments will be used to develop design criteria, and help avoid potentially disastrous discharging on spacecraft.

CONOPS: Upon deployment from the PPOD, SurfSat will power up and initially enter a charging phase. Antennas will deploy to enable communications with the ground and one Langmuir Probe boom will then be deployed. Data collection consists of voltage and current measurements from the dielectric surfaces on the experiment, and measurements from the Langmuir probes. We will program the spacecraft to record measurements while

in the polar regions, with occasional measurements outside of these regions for comparison. Probe and surface voltage measurements will be stored continuously during operation, but high data rate current data is recorded in a circular buffer, and only stored in long-term memory if triggered by an on-orbit ESD event. Data is stored onboard the computer until downlinked.

Materials: The primary CubeSat structure is made of 6061 Aluminum. In addition to the solar cells on the outside of the spacecraft, the sample materials are made of aluminum substrates with aerospace industry standard paints and coatings. These coupons are mounted with a non-conductive double-sided adhesive Kapton tape to a mounting panel on the outer frame of the spacecraft. The deployable antennas are made of guitar string wire, and the Langmuir probe is deployed on steel tape. The remaining components of the CubeSat contains all standard commercial off the shelf (COTS) materials, electrical components, and PCBs.

Hazards: There are no pressure vessels, hazardous or exotic materials.

Batteries: The electrical power storage system consists of COTS Lithium Iron Phosphate (LFP) batteries with over-charge/current protection circuitry (BatterySpace Model number LFP-1004045-WR, cells LFP-10004045-3C, UN38.3 passed).